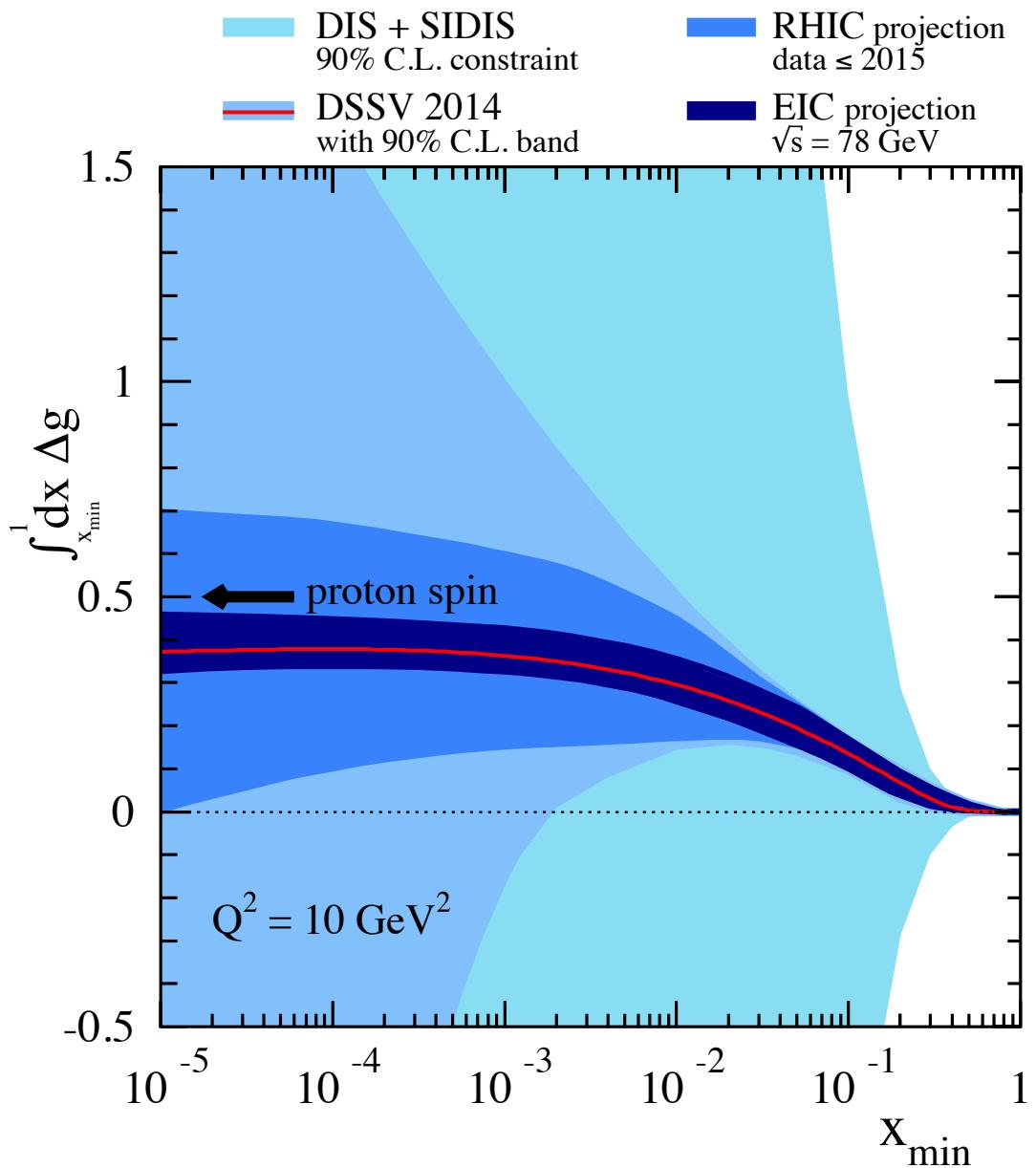
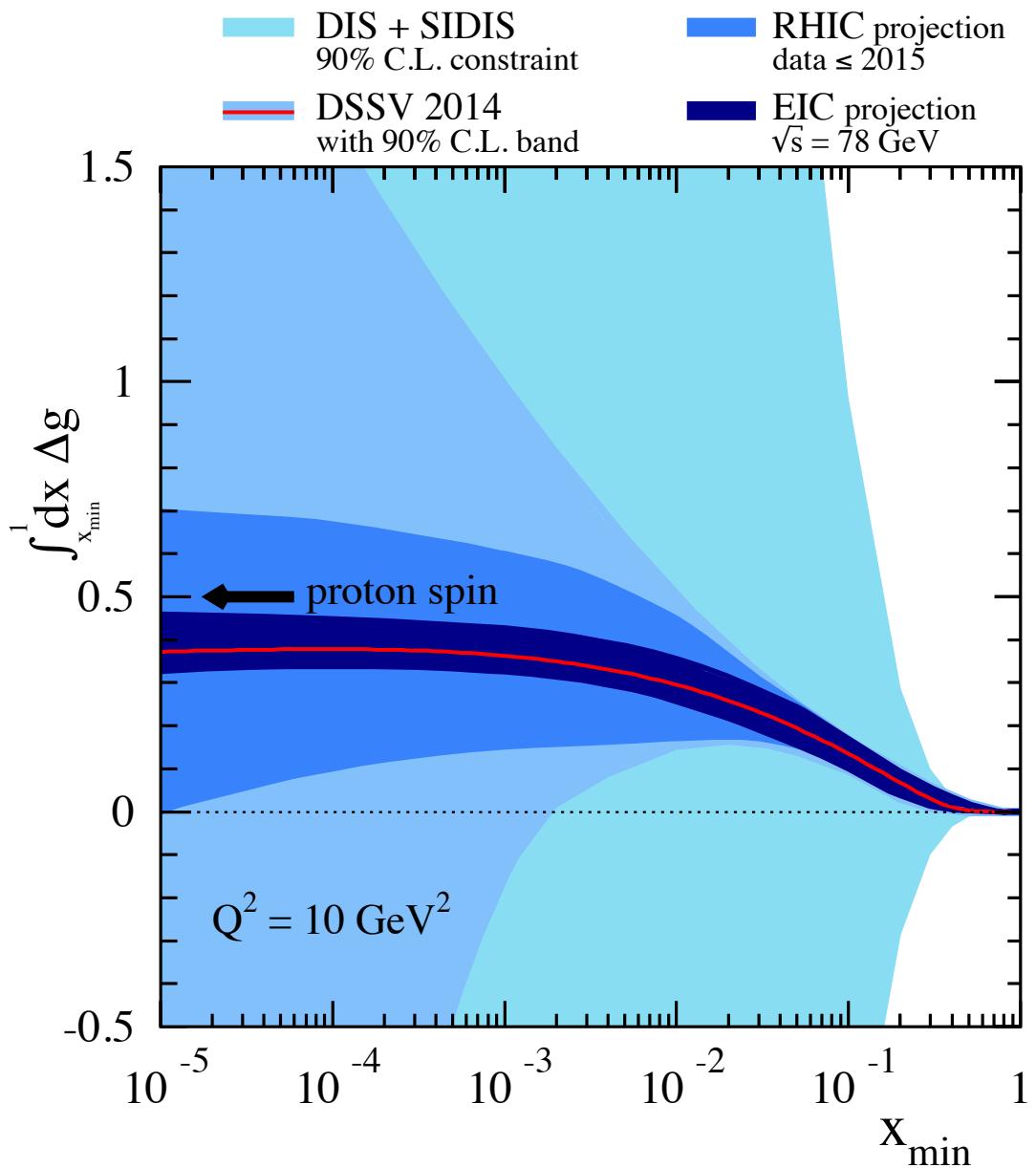


Investigations into low- x ΔG

Renee Fatemi
10-11-2015

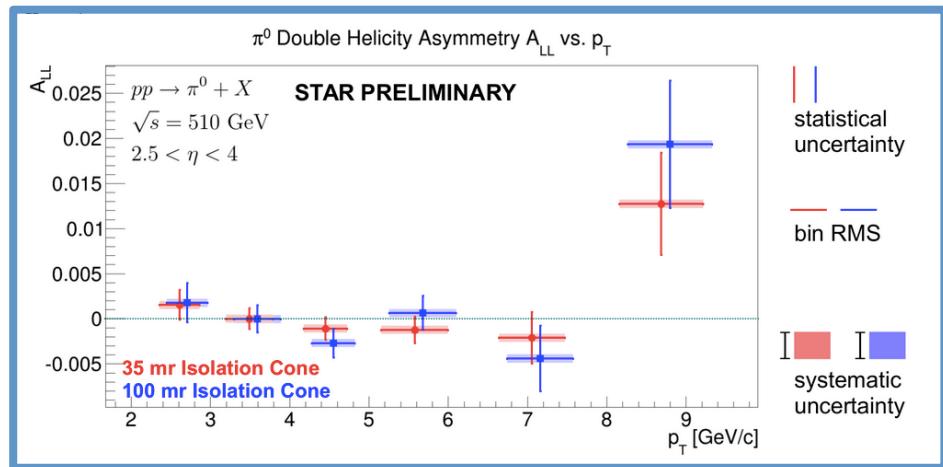


- 1) Need constraints for $x < (2 \times 10^{-2})$
- 2) Access low x in the forward region @ 500 GeV



Let's Review the Options

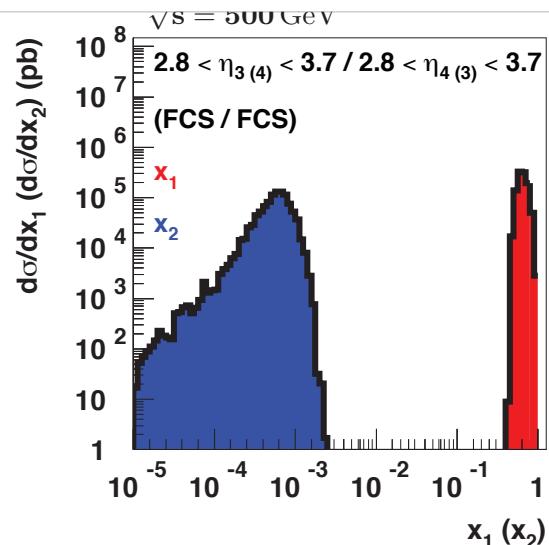
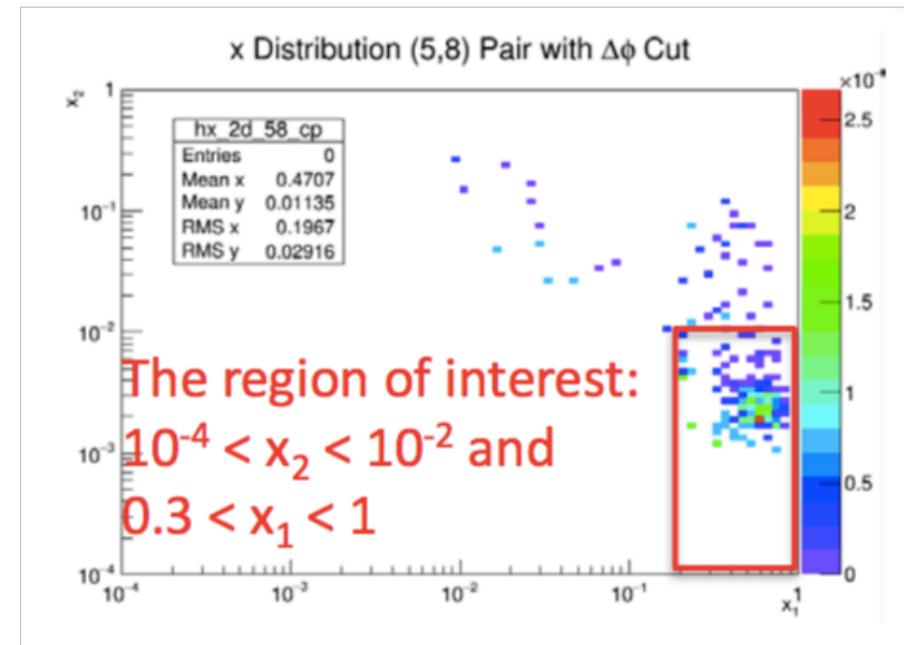
- Inclusive Observables
 - Inclusive π^0
 - Current stat error = ± 0.0007 from 382 pb $^{-1}$
 - Close to being limited by relative lumi error
 - Only needs ECAL
 - How many come from hard interaction vs UE?
 - Inclusive jet
 - Needs vertex reconstruction, ECAL +HCAL
 - Underlying event contribution may be large and polarized?



Problem with inclusive variables - they sample both high and low x leading to broad distribution and an effective dilution of the events we really want to sample. Will be hard to improve on the data in hand.

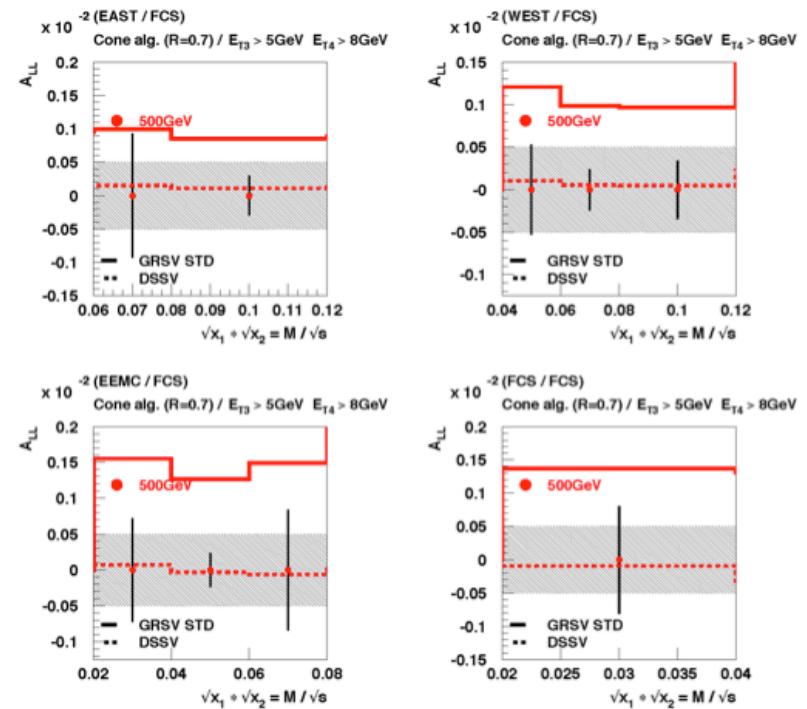
Let's Review the Options

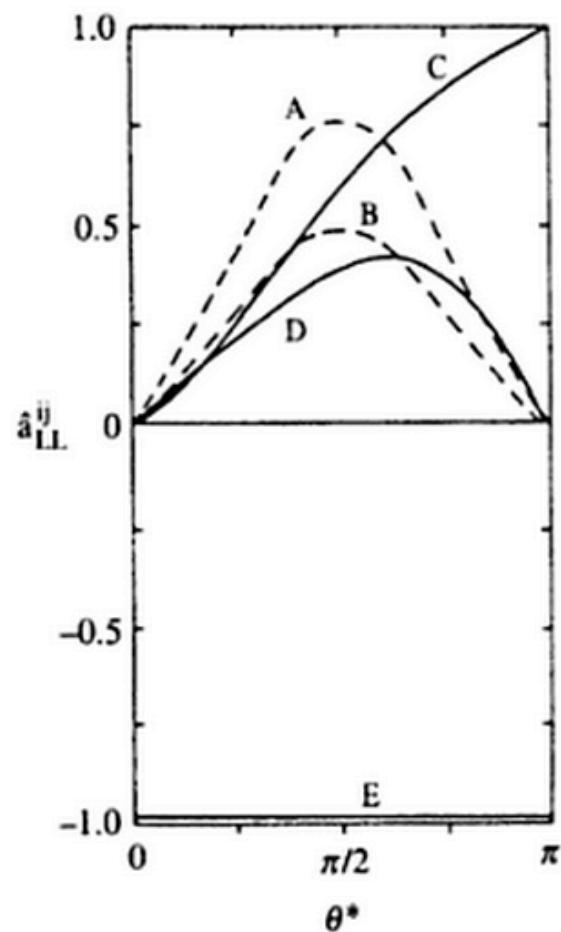
- More Exclusive Observables
 - Dijet
 - Needs vertex reconstruction, ECAL+HCAL
 - Underlying event contribution may be large and polarized!
 - Ability to “select” x range more finely by controlling eta ranges
 - Photon-jet
 - Once isolated it provides a clean scale , ie not modified by UE.
 - Isolation may be more difficult due to UE – perhaps set isolation threshold at UE value?
 - Dilution from q-qbar will likely increase from mid-rapidity
 - Rates decreased compared to di-jets. Maybe unfeasible.



Summary + Questions to answer

- Can we make a significant measurement for dijets with 1105 (775) pb-1 delivered (sampled)?
 - Figure 2.34 in STAR pp + pA LOI shows forward jet A_LL with cone R = 0.7. Anti-kT should be similar.
- What is the best way to deal with the UE in the forward direction?
 - Do we have a working PYTHIA tune?
 - Carl showed that with CDF Tune A UE and radiation “backgrounds” are uniform in $\Delta\phi$
- Does enhanced partonic aLL in forward region for qG-> gamma+quark compensate for reduced event rate compared to dijets? What is contribution from qqbar-> G+gamma with aLL = -1?
- What type of detectors?
 - ECAL + HCAL + vertex tracker
 - Rel Lumi monitor outside of eta region of measurement





A [$GG \rightarrow GG$

B [$dd \rightarrow dd$
 $uu \rightarrow uu$

C [$ud \rightarrow ud$
 $u\bar{d} \rightarrow u\bar{d}$
 $d\bar{u} \rightarrow d\bar{u}$
 $qG \rightarrow qG$
 $qG \rightarrow q\gamma$

D [$u\bar{u} \rightarrow u\bar{u}$
 $d\bar{d} \rightarrow d\bar{d}$

E [$GG \rightarrow q\bar{q}$
 $q\bar{q} \rightarrow GG$
 $u\bar{u} \rightarrow d\bar{d}$
 $d\bar{d} \rightarrow u\bar{u}$
 $q\bar{q} \rightarrow G\gamma$

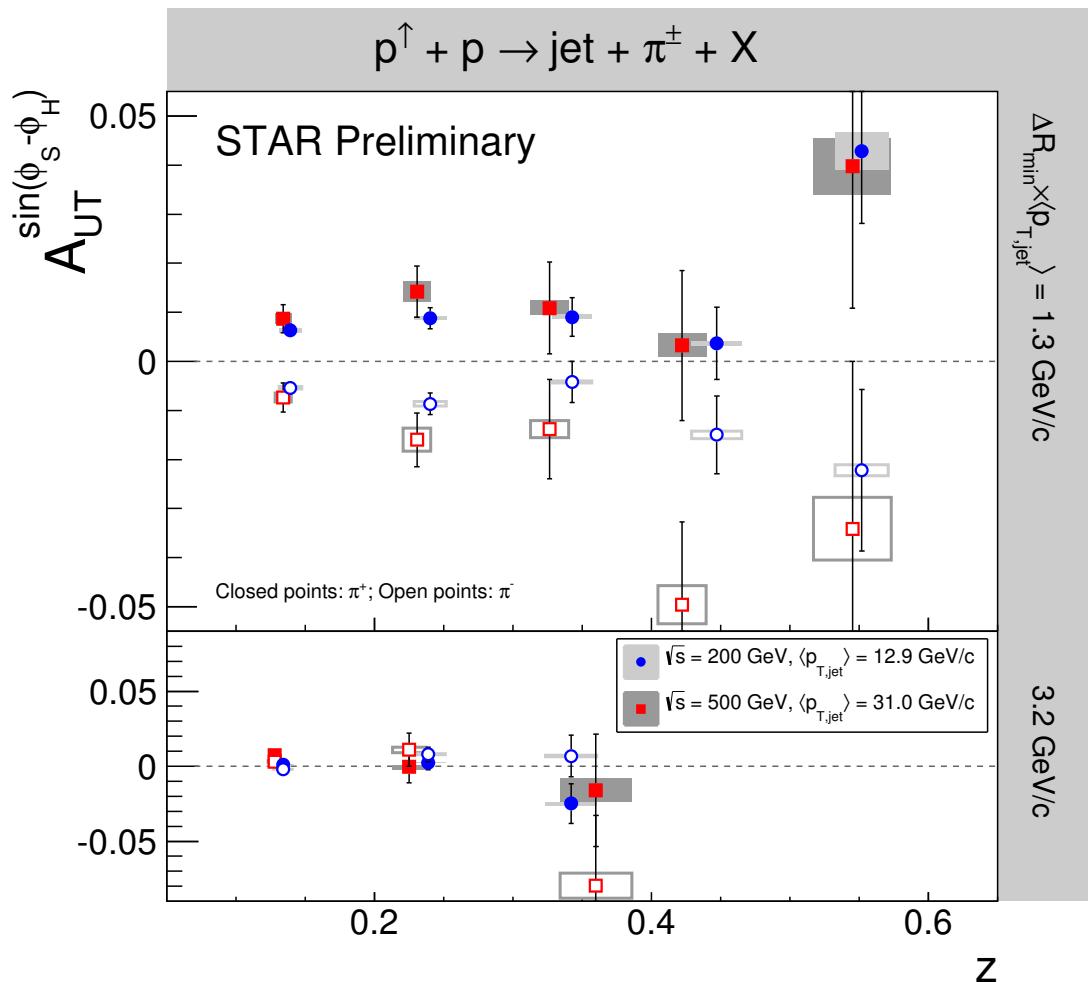
Investigations into Physics using Jet A_{UT}

YEAR	\sqrt{s}	L (pb-1)	<pol>
2011	500	25	53.5
2012	200	22	59.5
2015	200	52	57
2017	500	400	50

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10-11-2015*

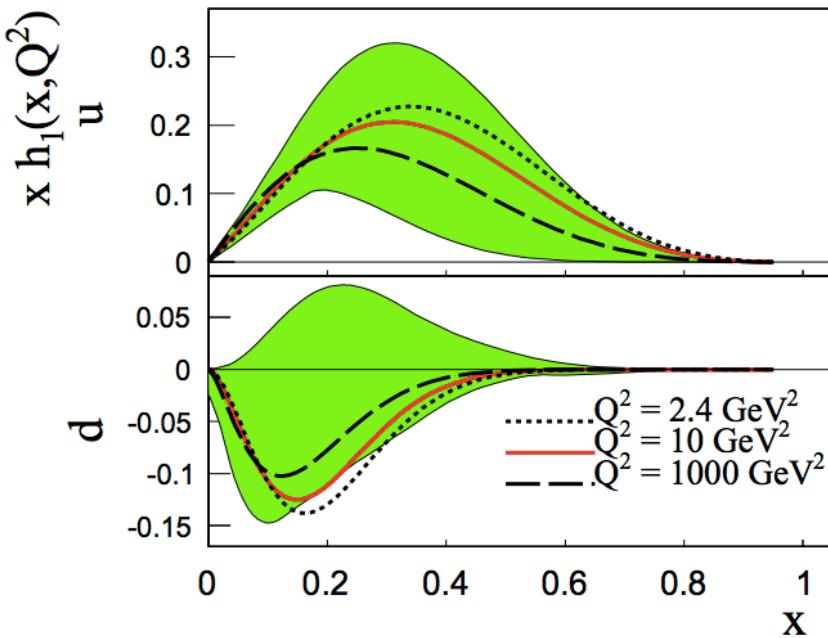
Lets Review the Options

- Transversity x Collins
 - Mid-rapidity \sqrt{s} = **200** and **500**
 - One jet p_T bin shown
 - Error bars for 500 will reduce by x4 from Run 17 data.
 - Error bars for 200 GeV will reduce by $\sqrt{2}$ from Run 15 data.
 - Hard to motivate further mid-rapidity running at this point

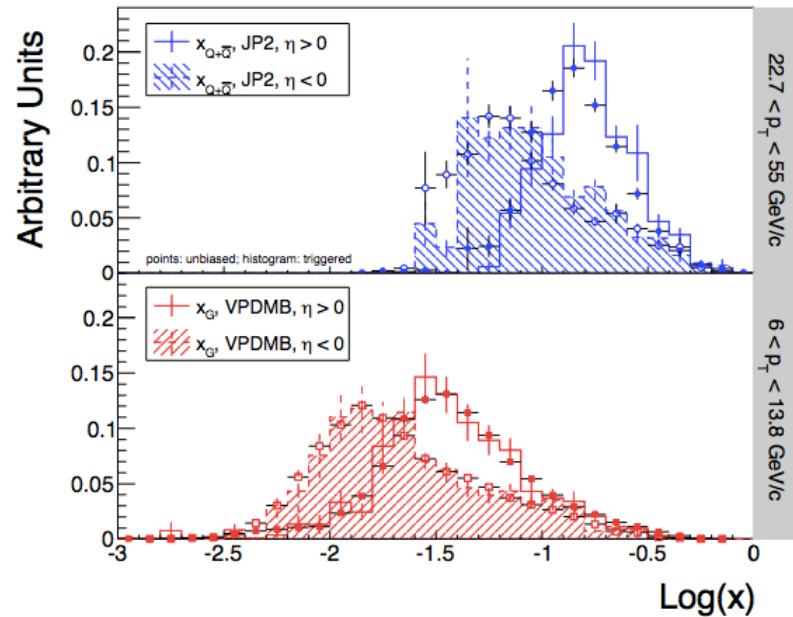


Lets Review the Options

- Transversity x Collins
 - $\langle x \rangle$ midrapidity ~ 0.2



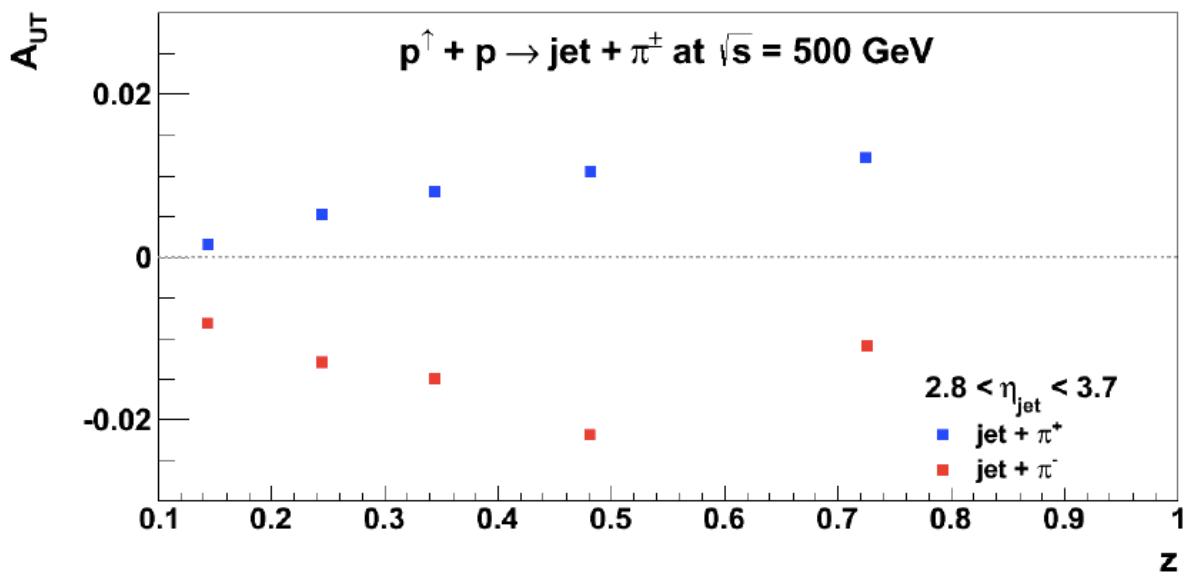
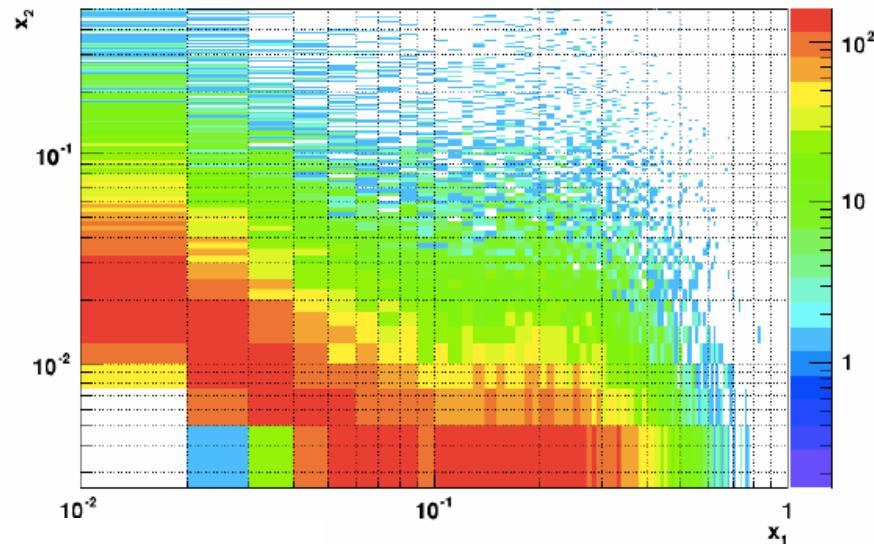
arXiv: 1505.05589



- Green bands are 90% CL errors at $Q^2 = 10 \text{ GeV}$.
- Significant uncertainty for $x > 0.4$
- Forward jets accesses

Lets Review the Options

- Transversity x Collins
 - With $pT > 3$ GeV and $\eta = 2.8 - 3.5$ can easily access $x = 0.4$ and out to 0.6
 - Raising $pT > 5$ GeV pushes $\langle x \rangle$ out to 0.3 - 0.4

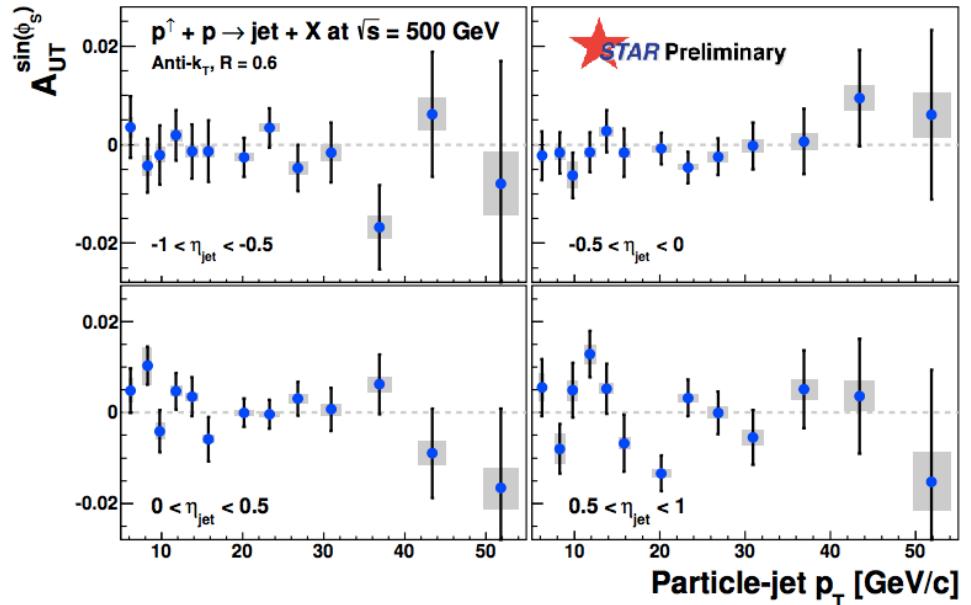


Estimated errors for 1 fb^{-1} and 60% polarization at 500 GeV using Torino parameterization inserted into PYTHIA CDF Tune A simulation.

Lets Review the Options

Initial State:

- Twist-3 “Sivers-like” correlators via inclusive jets
Measured to be \sim zero at mid-rapidity in 200 and 500 GeV. Sensitive to gluon correlators.



- Pushing forward gives more sensitivity to quark Sivers.

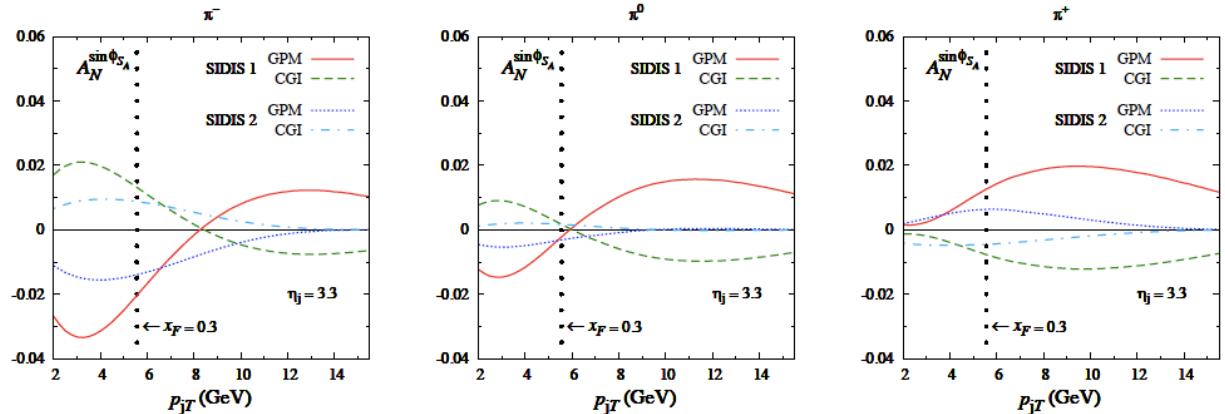


FIG. 1. The Sivers asymmetry $A_N^{\sin \phi_{SA}}$ for the $p^\uparrow p \rightarrow \text{jet } \pi + X$ as a function of p_{jT} , at fixed jet rapidity $\eta_j = 3.3$, for RHIC energy, $\sqrt{s} = 500$ GeV. The solid (SIDIS 1 [29]) and dotted (SIDIS 2 [25]) curves are for the GPM calculation, and the dashed and dot-dashed ones for the CGI GPM calculation. The vertical dotted line corresponds to $x_F = 0.3$.

Required Detectors

- ECAL + HCAL
- Vertex tracking for jets
- PID? or just fall back to charge sign separation
in Silicon?